SOLAS OLED LTD.

v.

SAMSUNG DISPLAY CO., LTD., et al.

Solas's Tutorial

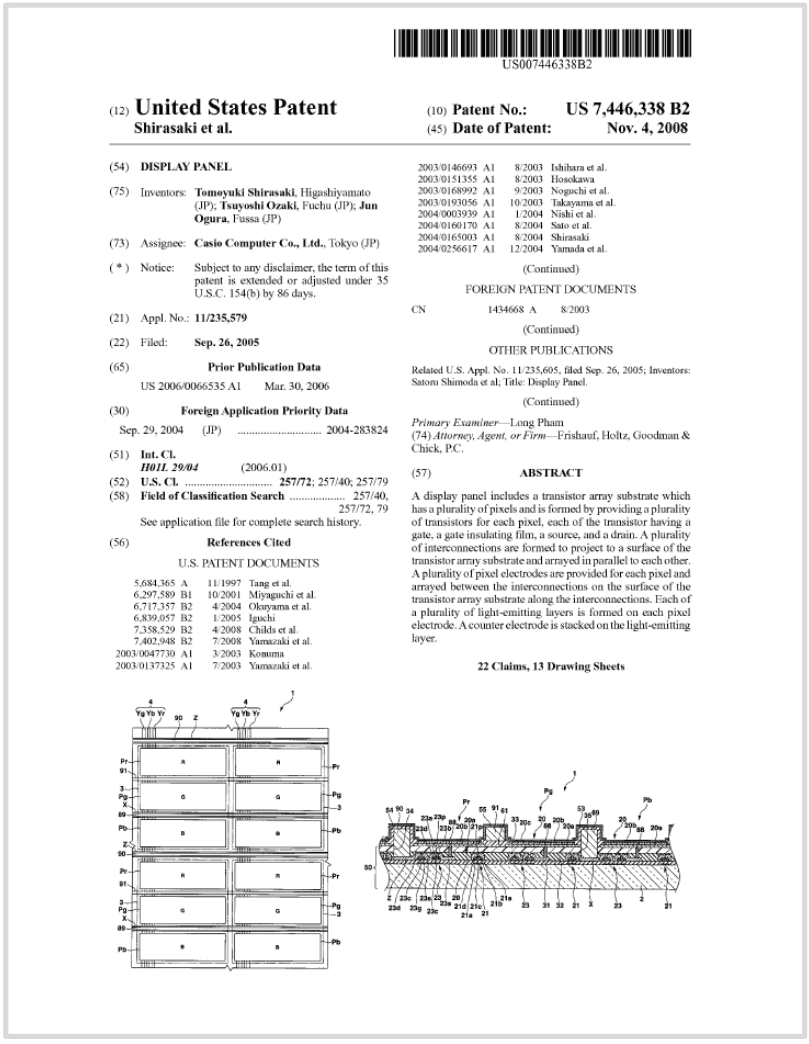
Case No. 2:19-cv-00152-JRG

Overview

’338 patent

’311 patent

U.S. Patent No. 7,446,338 ("'338 Patent")



US007446338B2

(12) **United States Patent**
Shirasaki et al.

(10) **Patent No.: US 7,446,338 B2**
(45) **Date of Patent: Nov. 4, 2008**

(54) **DISPLAY PANEL**

(75) Inventors: **Tomoyuki Shirasaki**, Higashiyamato (JP); **Tsuyoshi Ozaki**, Fuchu (JP); **Jun Ogura**, Fussa (JP)

(73) Assignee: **Casio Computer Co., Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 86 days.

(21) Appl. No.: **11/235,579**

(22) Filed: **Sep. 26, 2005**

(65) **Prior Publication Data**

US 2006/0066535 A1 Mar. 30, 2006

(30) **Foreign Application Priority Data**

Sep. 29, 2004 (JP) 2004-283824

(51) **Int. Cl.**
H01L 29/04 (2006.01)

(52) **U.S. Cl.** **257/72**; 257/40; 257/79

(58) **Field of Classification Search** 257/40, 257/72, 79

See application file for complete search history.

(56) **References Cited**

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Related U.S. Appl. No. 11/235,605, filed Sep. 26, 2005; Inventors: Satoru Shimoda et al; Title: Display Panel.

(Continued)

Primary Examiner—Long Pham
(74) *Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman & Chick, P.C.

(57) **ABSTRACT**

A display panel includes a transistor array substrate which has a plurality of pixels and is formed by providing a plurality of transistors for each pixel, each of the transistor having a gate, a gate insulating film, a source, and a drain. A plurality of interconnections are formed to project to a surface of the transistor array substrate and arrayed in parallel to each other. A plurality of pixel electrodes are provided for each pixel and arrayed between the interconnections on the surface of the transistor array substrate along the interconnections. Each of a plurality of light-emitting layers is formed on each pixel electrode. A counter electrode is stacked on the light-emitting layer.

22 Claims, 13 Drawing Sheets

Title: Display Panel

Inventors: Tomoyuki Shirasaki, Tsuyoshi Ozaki, Jun Ogura

Filing Date: September 26, 2005

Display Technologies

CRT **LCD** **OLED**

Organic Light Emitting Diode (OLED) Display Panel

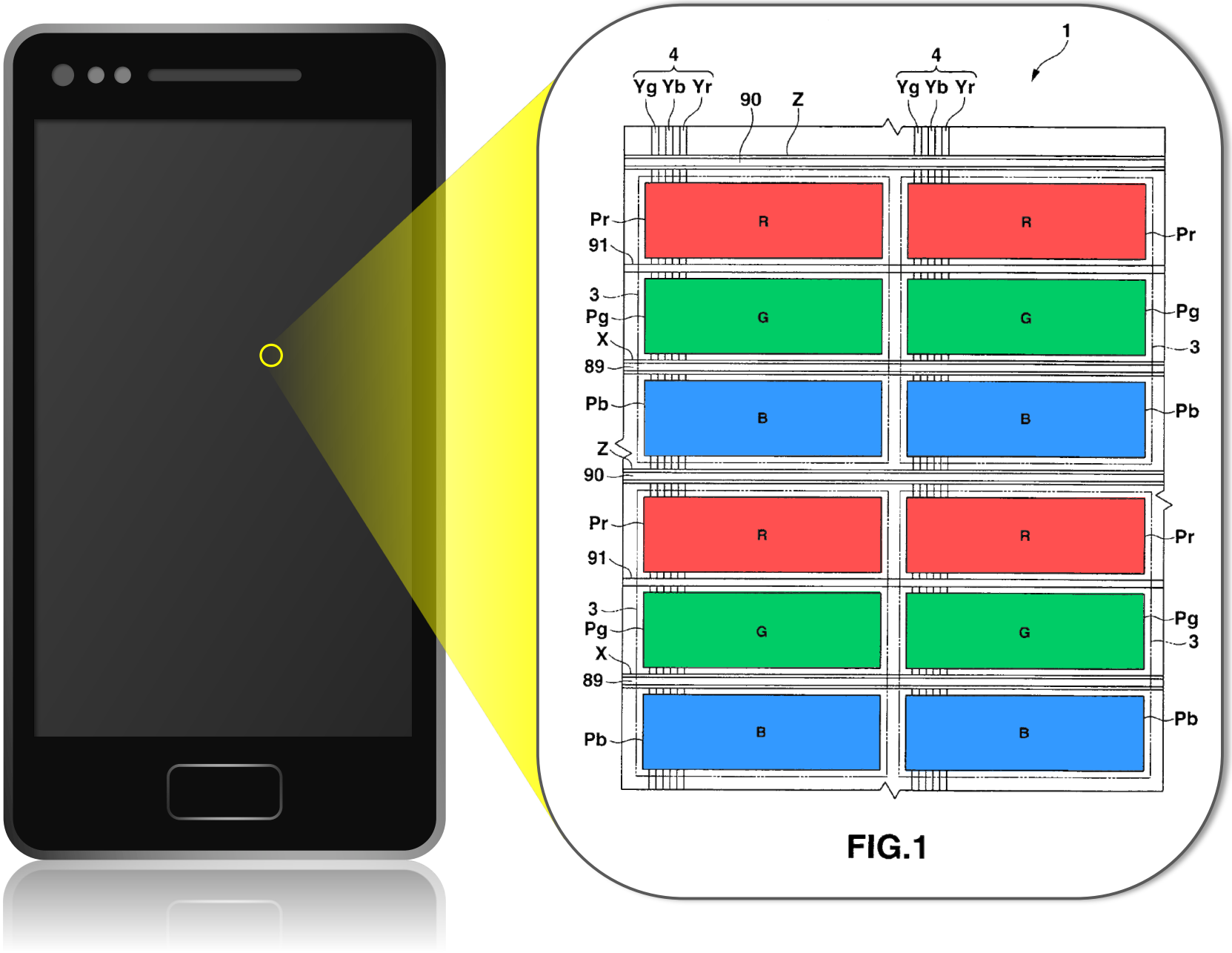


FIG.1

The Patent is Directed to ”Active Matrix Type” OLED

2. Description of the Related Art

Organic electroluminescent panels can roughly be classified into passive driving types and active matrix types. Organic electroluminescent panels of ***active matrix type are more excellent than those of passive driving types because of high contrast and high resolution***.

Col. 1: 16-21.

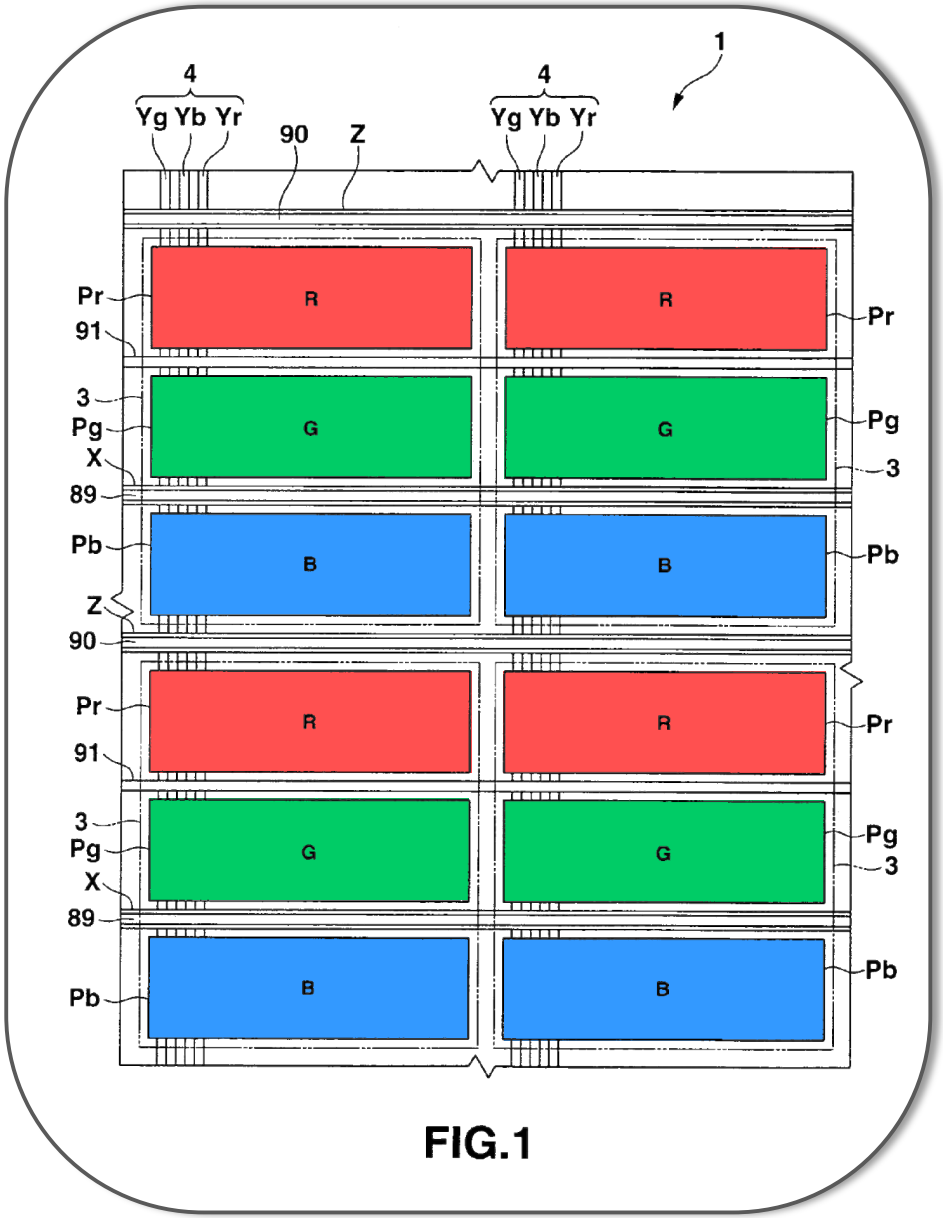


FIG.1

The Patent Teaches Writing Brightness Values to Each Pixel

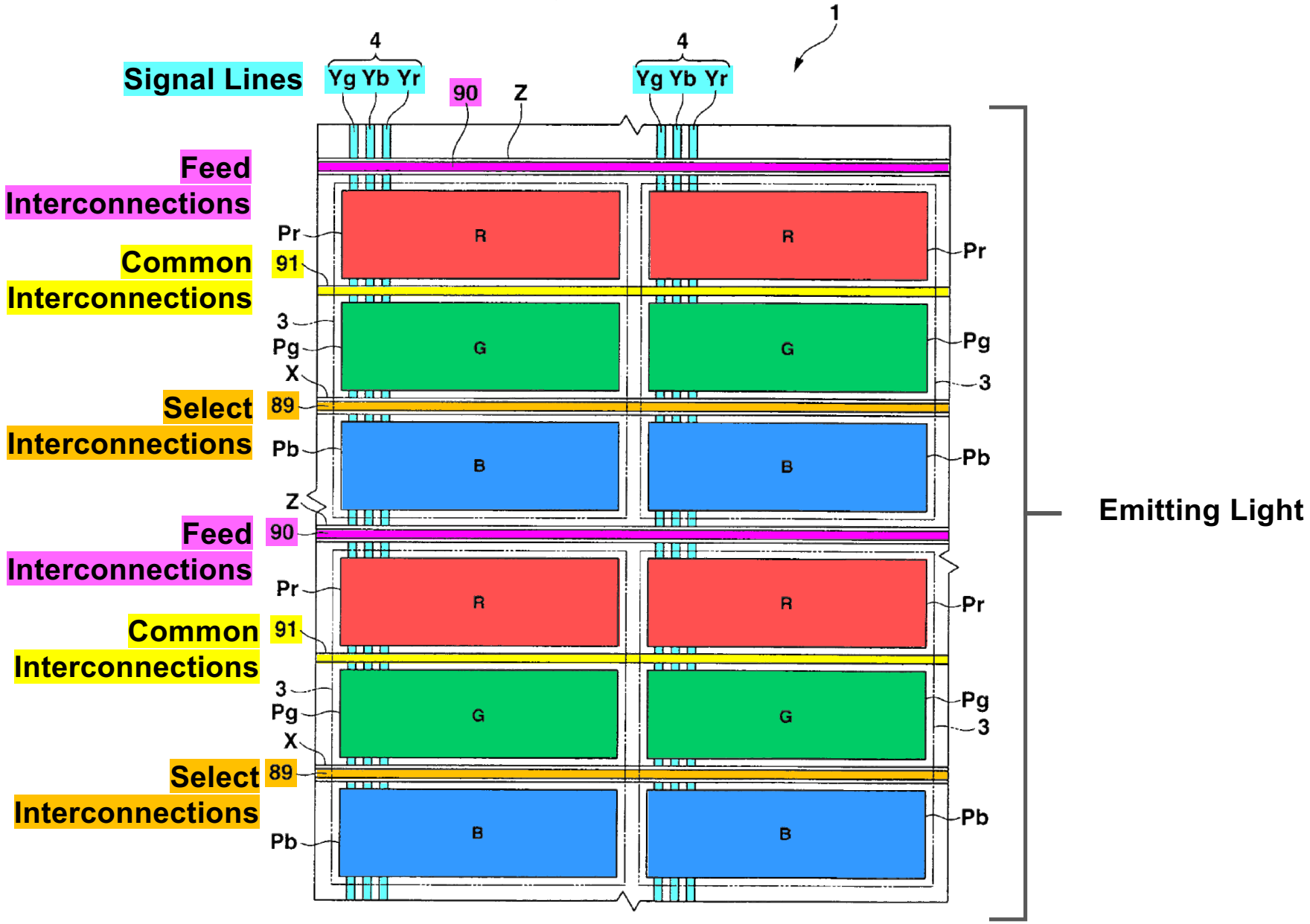


FIG.1

Example: Writing Brightness Signals into First Row of Pixels

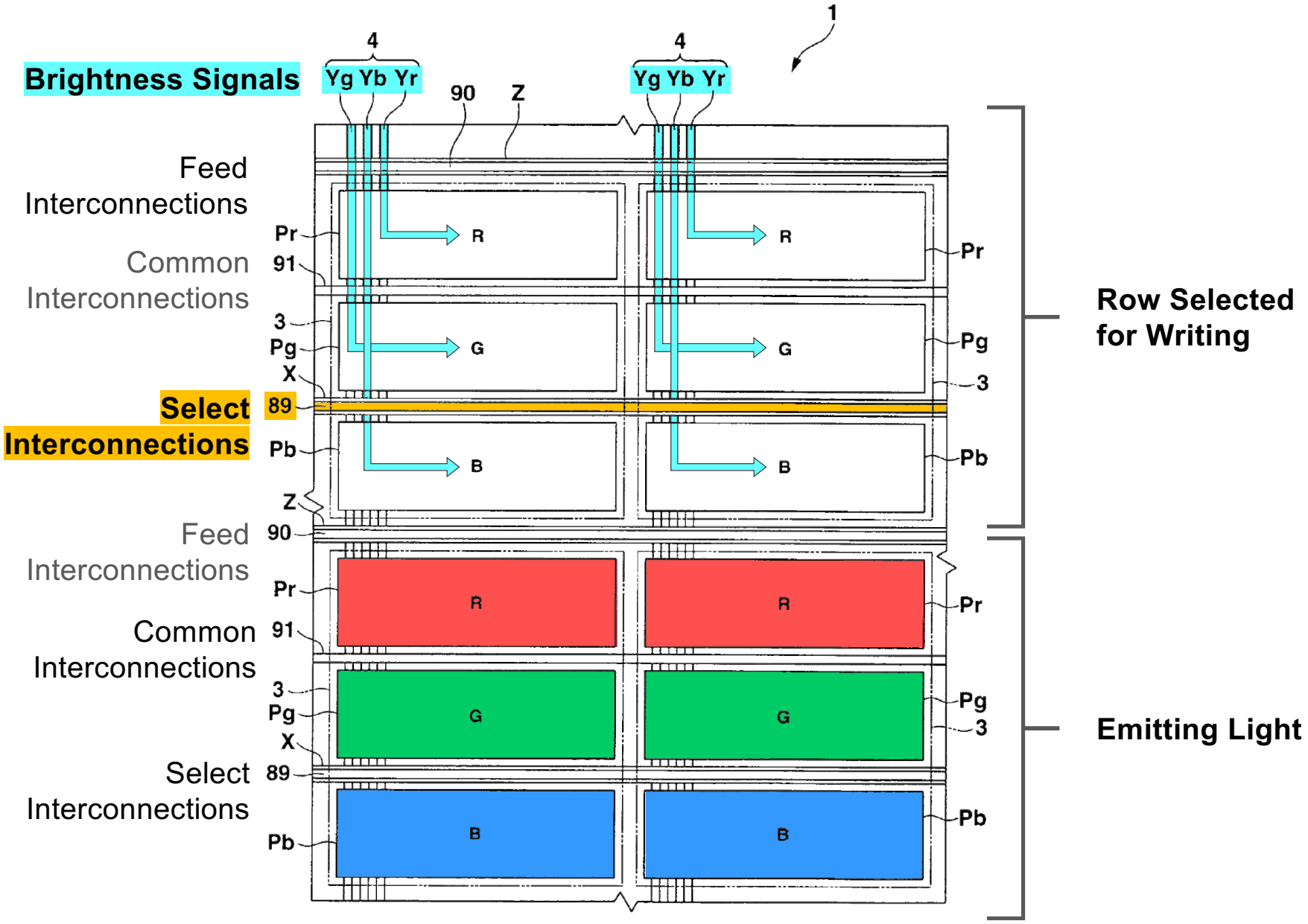


FIG.1

Writing Brightness Signals into Second Row of Pixels

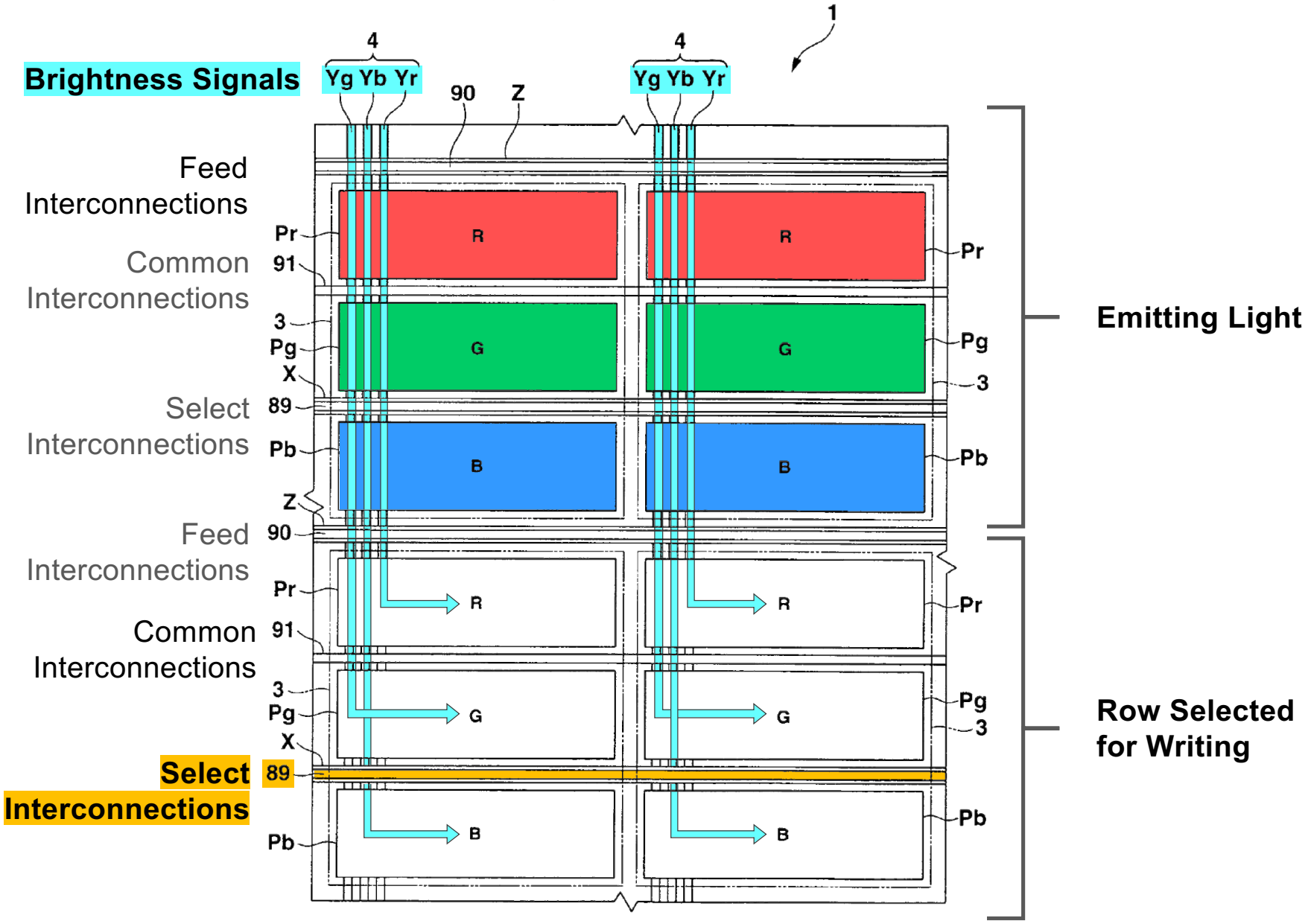


FIG.1

Pixel Circuits Formed as Layered Structure

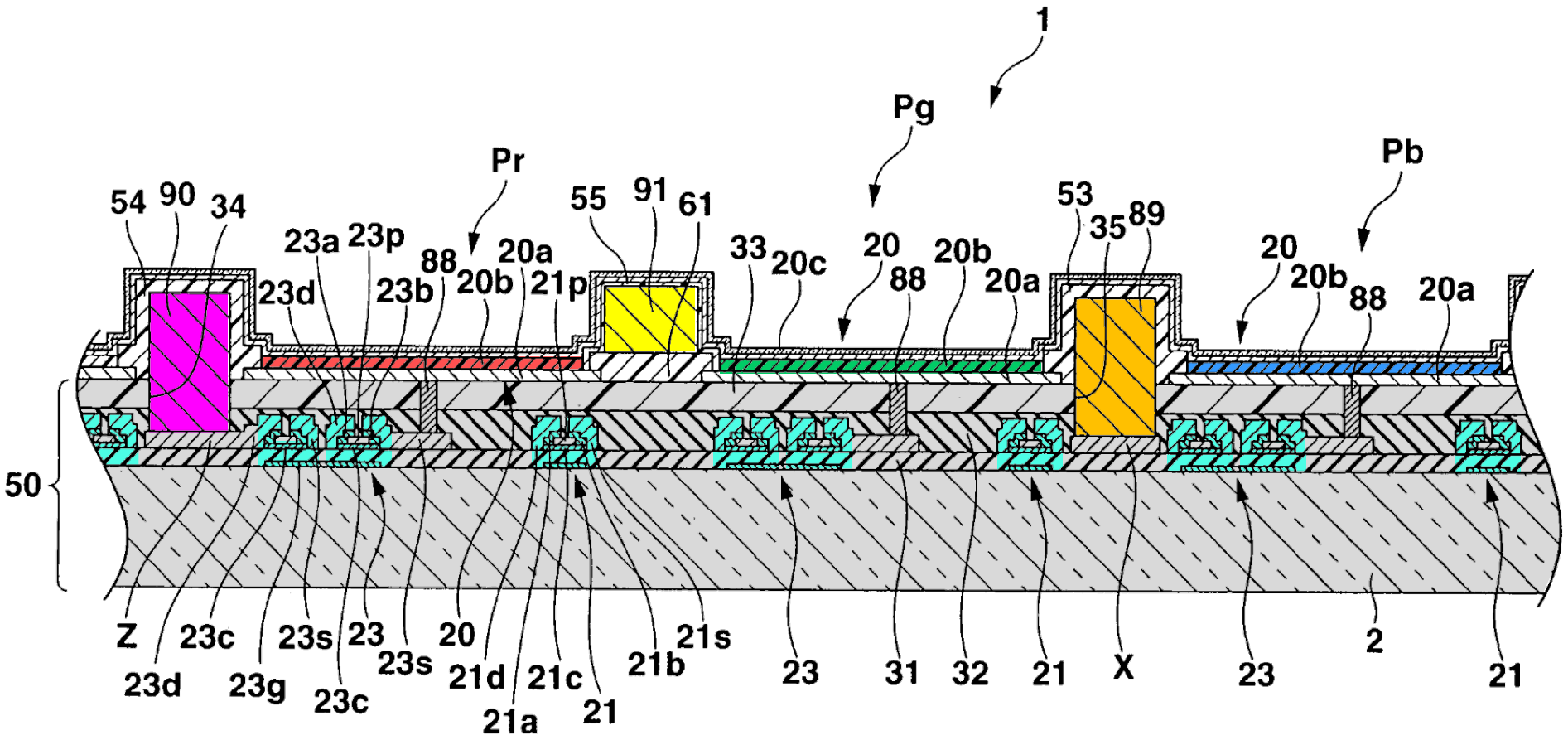


FIG.6

Transistor Array Substrate | Transistors | Interconnections

Pixel Circuit Schematic

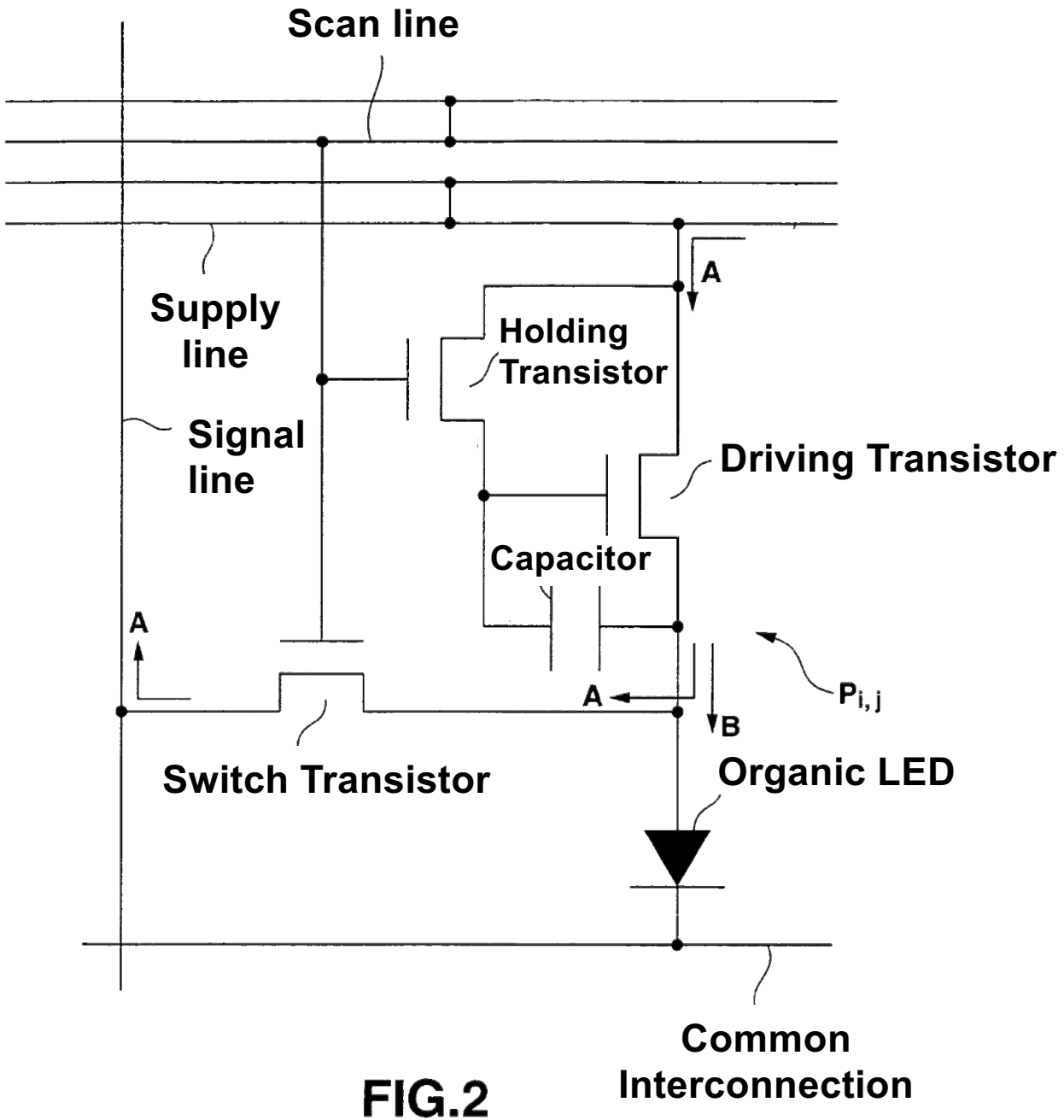


FIG.2

Pixel Circuit Schematic – Writing the Brightness Signal

Row Selected for Writing

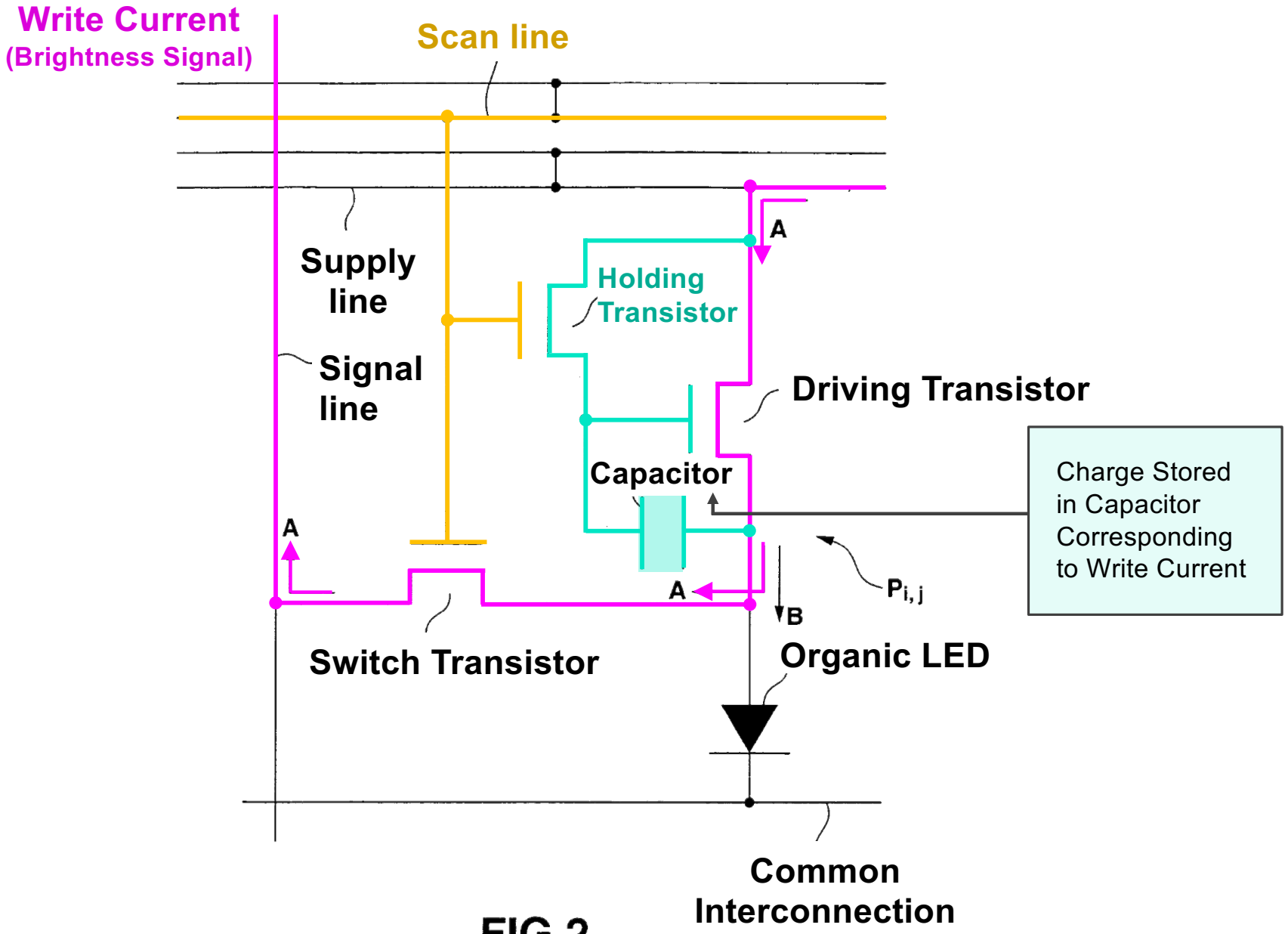


FIG.2

Pixel Circuit Schematic – Emitting Light

Row Not Selected

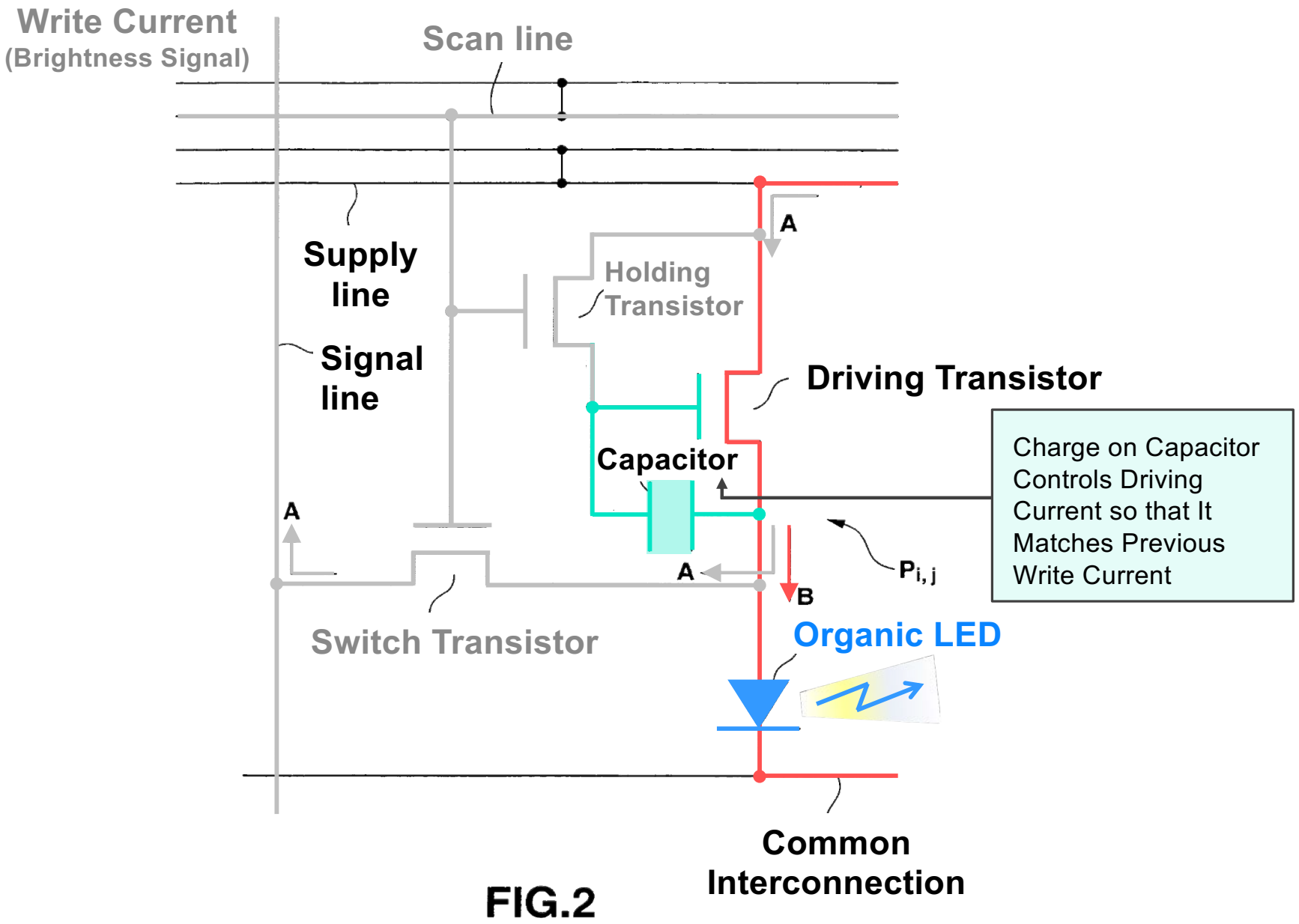


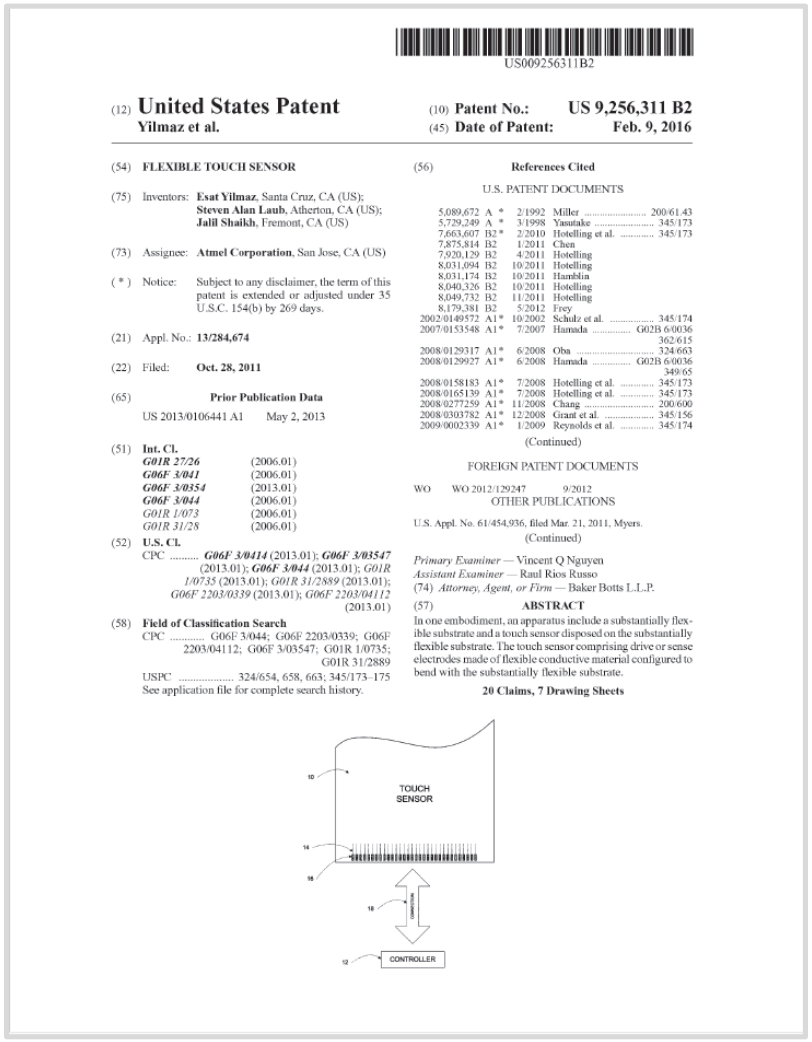
FIG.2

Overview

’338 patent

’311 patent

U.S. Patent No. 9,256,311 ("'311 Patent")



US009256311B2

(12) **United States Patent**
Yilmaz et al.

(10) **Patent No.: US 9,256,311 B2**
(45) **Date of Patent: Feb. 9, 2016**

(54) **FLEXIBLE TOUCH SENSOR**

(75) Inventors: **Esat Yilmaz**, Santa Cruz, CA (US); **Steven Alan Laub**, Atherton, CA (US); **Jalil Shaikh**, Fremont, CA (US)

(73) Assignee: **Atmel Corporation**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 269 days.

(21) Appl. No.: **13/284,674**

(22) Filed: **Oct. 28, 2011**

(65) **Prior Publication Data**

US 2013/0106441 A1 May 2, 2013

(51) **Int. Cl.**

G01R 27/26	(2006.01)
G06F 3/041	(2006.01)
G06F 3/0354	(2013.01)
G06F 3/044	(2006.01)
G01R 1/073	(2006.01)
G01R 31/28	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/0414*** (2013.01); ***G06F 3/03547*** (2013.01); ***G06F 3/044*** (2013.01); *G01R 1/0735* (2013.01); *G01R 31/2889* (2013.01); *G06F 2203/0339* (2013.01); *G06F 2203/04112* (2013.01)

(58) **Field of Classification Search**

CPC G06F 3/044; G06F 2203/0339; G06F 2203/04112; G06F 3/03547; G01R 1/0735; G01R 31/2889

USPC 324/654, 658, 663; 345/173–175

See application file for complete search history.

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Primary Examiner — Vincent Q Nguyen
Assistant Examiner — Raul Rios Russo
(74) *Attorney, Agent, or Firm* — Baker Botts L.L.P.

(57) **ABSTRACT**

In one embodiment, an apparatus include a substantially flexible substrate and a touch sensor disposed on the substantially flexible substrate. The touch sensor comprising drive or sense electrodes made of flexible conductive material configured to bend with the substantially flexible substrate.

20 Claims, 7 Drawing Sheets

Title: Flexible Touch Sensor

Inventors: Esat Yilmaz, Steven Alan Laub, Jalil Shaikh

Filing Date: October 28, 2011

The Patent Teaches and Claims Novel Touch-Position Sensing In Electronic Devices

BACKGROUND

A touch-position sensor may detect the presence and location of a touch or the proximity of an object (such as a user's finger or a stylus) within a touch-sensitive area of the touch sensor overlaid on a display screen, for example. In a touch sensitive display application, the touch position sensor may enable a user to interact directly with what is displayed on the screen, rather than indirectly with a mouse or touch pad. A touch sensor may be attached to or provided as part of a desktop computer, laptop computer, tablet computer, personal digital assistant (PDA), smartphone, satellite navigation device, portable media player, portable game console, kiosk computer, point-of-sale device, or other suitable device. A control panel on a household or other appliance may include a touch sensor.

Various Types of Touch Sensing Technologies Were Generally Known

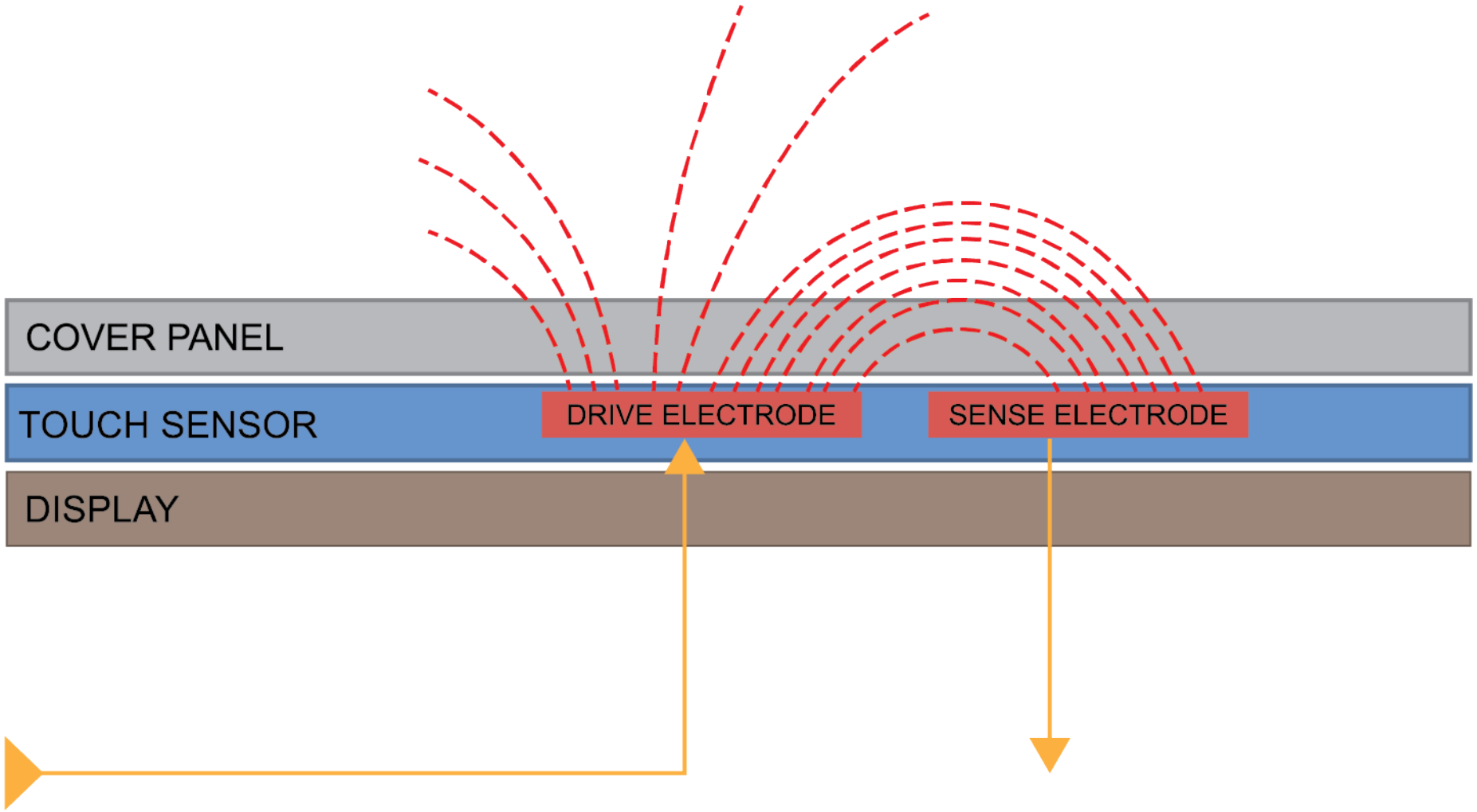
Resistive Sensing

Inductive Sensing

Capacitive Sensing

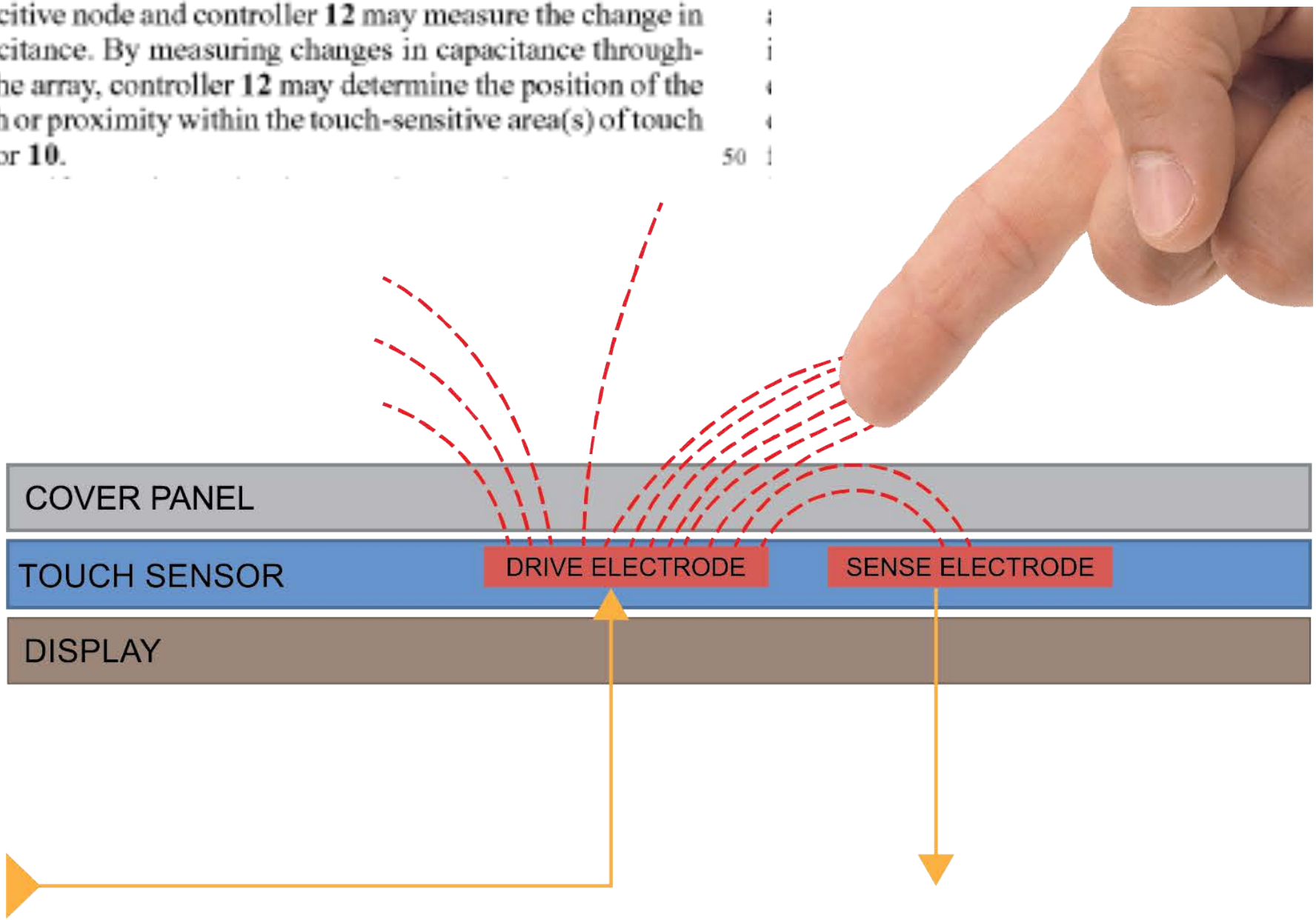
311 Patent Specifically Concerns Capacitive Touch Sensing

Herein, reference to a touch sensor may encompass a touch screen, and vice versa, where appropriate. When an object touches or comes within proximity of the surface of the capacitive touch screen, a change in capacitance may occur within the touch screen at the location of the touch or proximity. A controller may process the change in capacitance to determine its position on the touch screen.



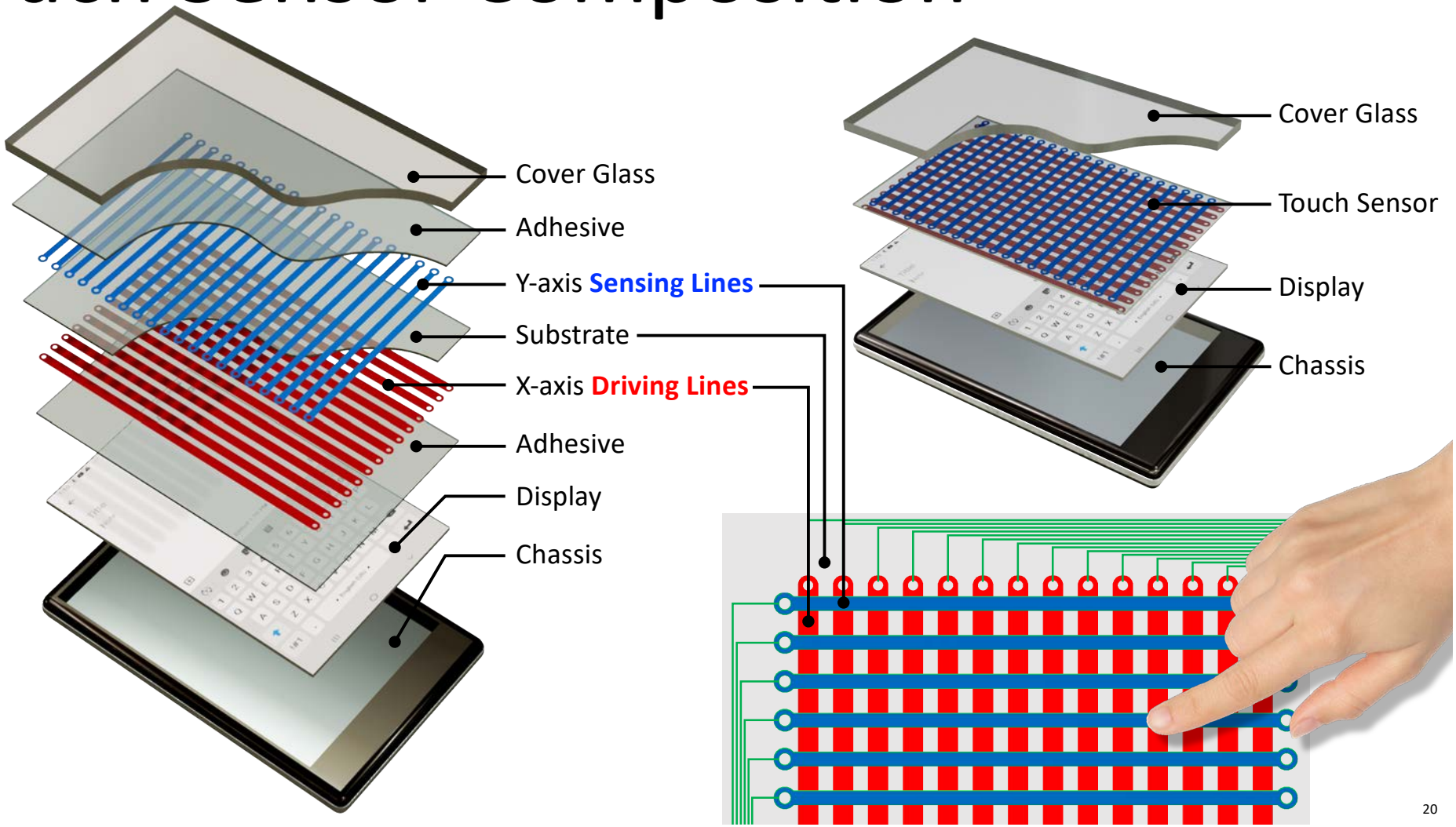
Capacitive Touch Sensing

When an object touches or comes within proximity of the capacitive node, a change in capacitance may occur at the capacitive node and controller **12** may measure the change in capacitance. By measuring changes in capacitance throughout the array, controller **12** may determine the position of the touch or proximity within the touch-sensitive area(s) of touch sensor **10**.



Illustrative Components In Display/Sensor Stack

Touch Sensor Composition



Patent Teaches Various Sensor Materials and Designs, Including "Mesh"

'311 2-15:20
As an example and not by way of limitation, an electrode may be made of fine lines of metal or other conductive material (Such as for example copper, silver, or a copper- or silver-based material) and the fine lines of conductive material may occupy approximately 5% of the area of its shape in a hatched, mesh, or other Suitable pattern.

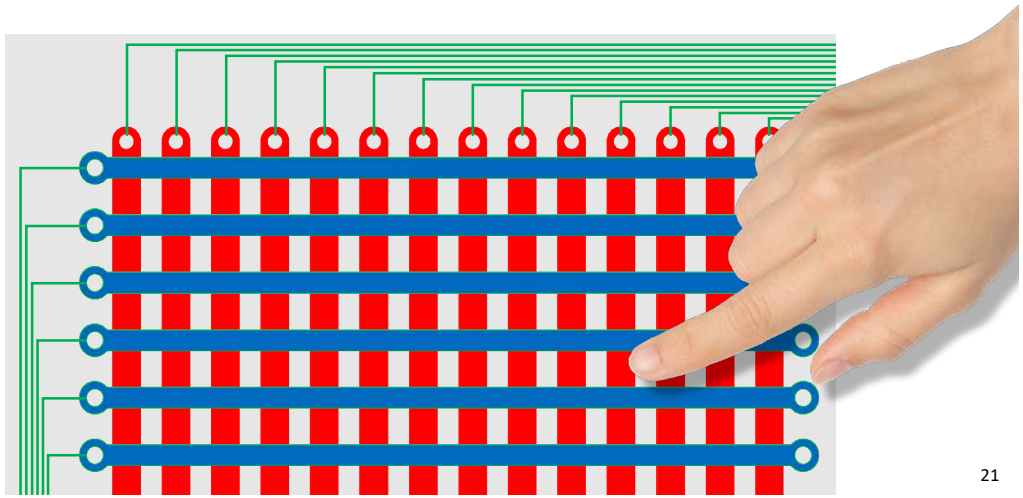


Figure 2 A: "Mesh" Conductive Sensor Substrate

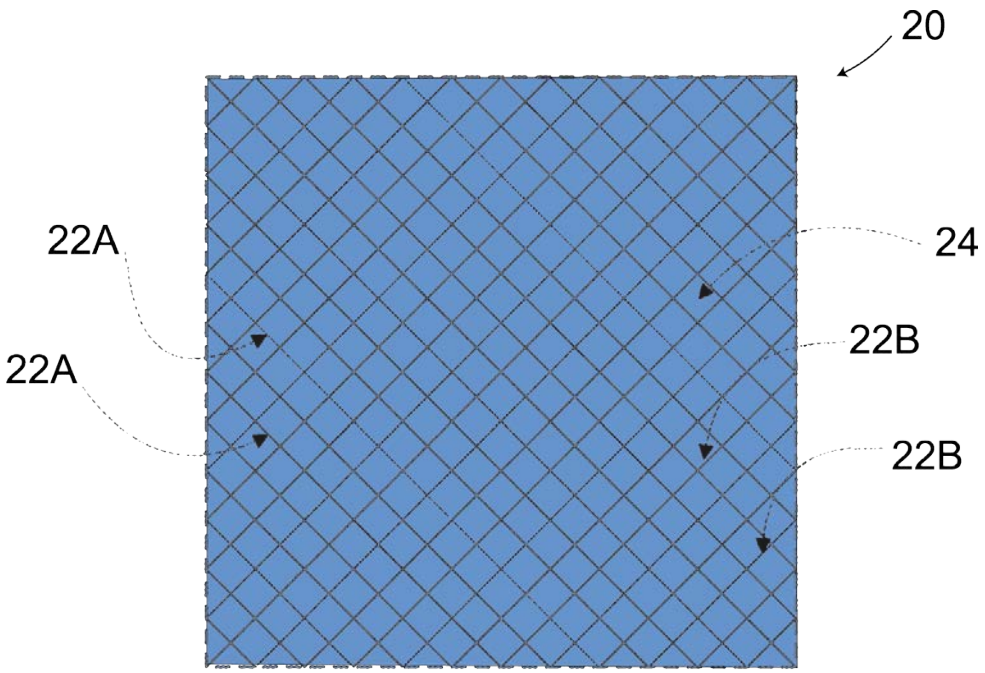


Figure 2A

'311 6-3:13
As an example and not by way of limitation, first set 22A and second set 22B of conducting lines may be disposed such that a total line density is less than approximately 10% of a surface area. Thus, the contribution of the conductive lines to the reduction of transmission of light through mesh pattern 20 may be less than approximately 10%. Accordingly,
although conductive lines 22A-B may be opaque, the combined optical transmittance of electrodes formed using mesh pattern 20 may be approximately 90% or higher ignoring reduction in transmittance due to other factors such as the substantially flexible substrate material.

Figure 2 B: "Mesh" Conductive Sensor

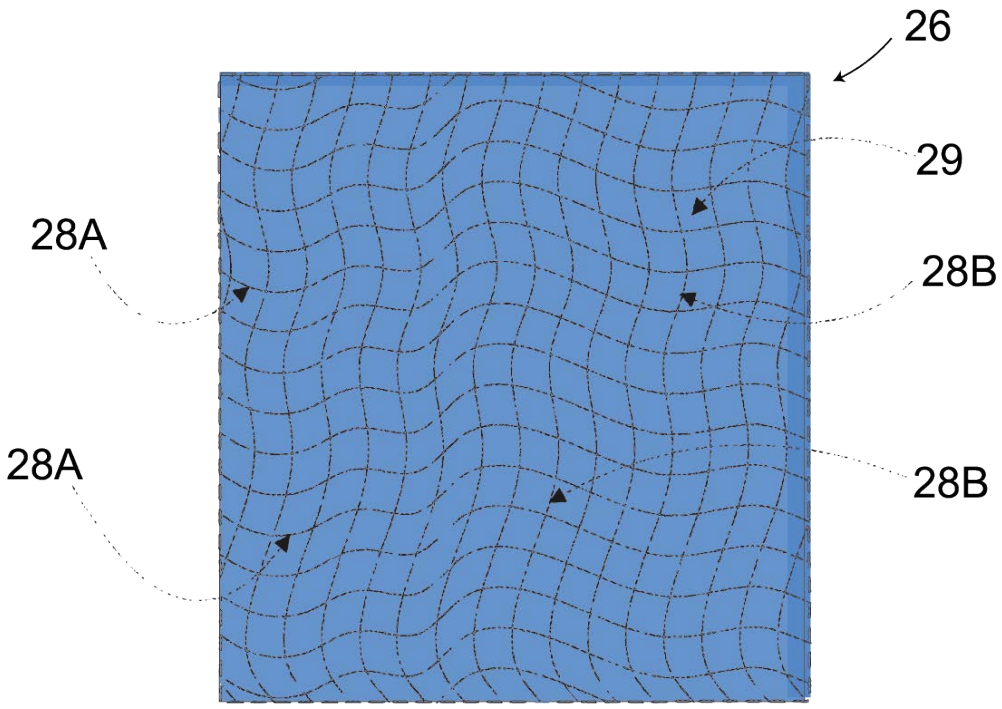
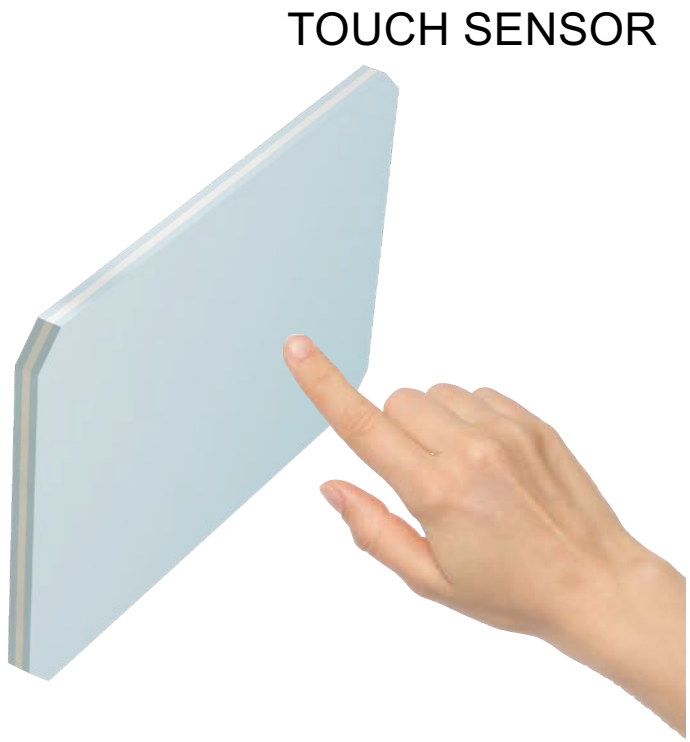


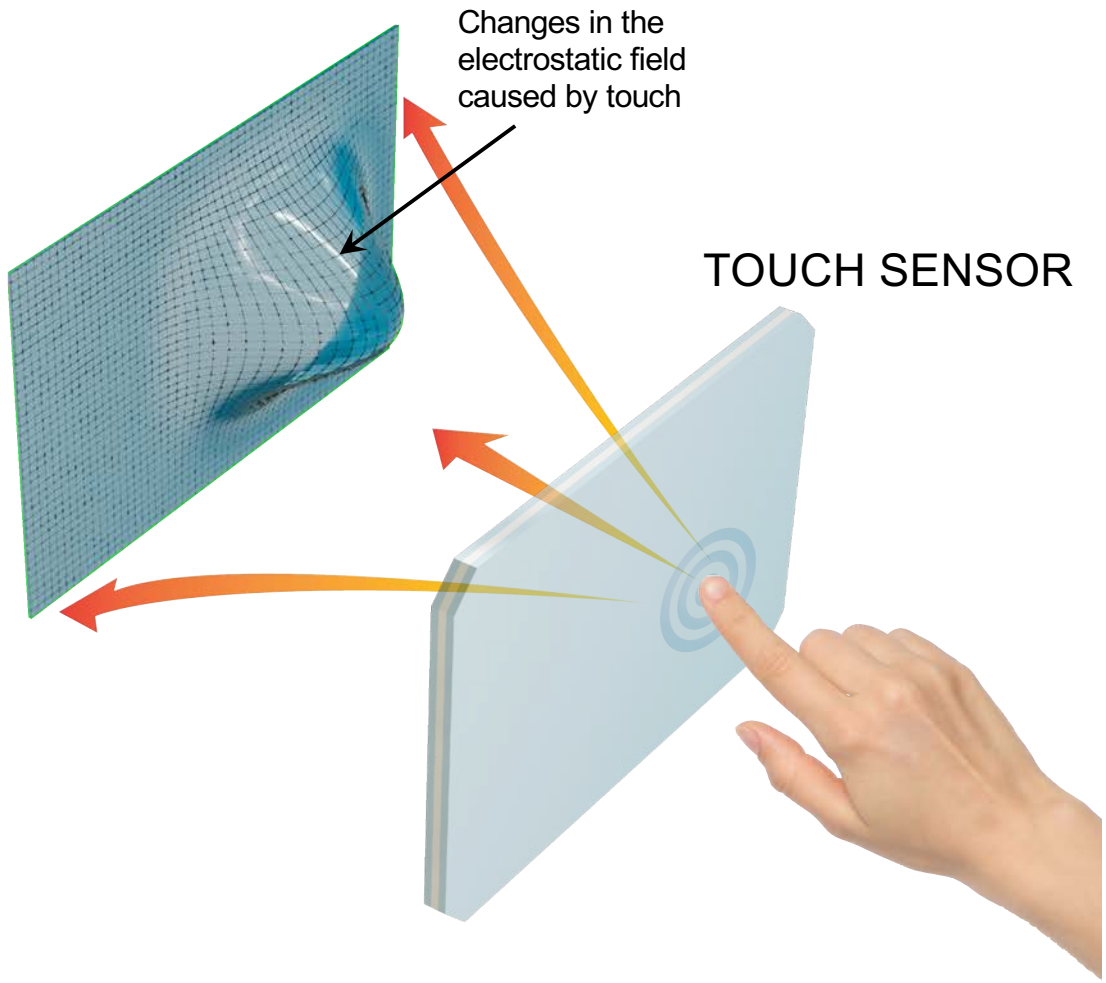
Figure 2B

'311 6-14:22
In the example of FIG. 2B, mesh pattern 26 may be formed from substantially non-linear conductive lines 28A-B. Non
linear line patterns 28A-B may be used to avoid long linear stretches of fine metal with a repeat frequency, reducing a probability of causing interference or moiré patterns. The non-linear pattern of the conductive lines 28A-B of mesh pattern 26 may disperse and hence reduce the visibility of reflections from conductive lines 28A-B when illuminated by incident light.

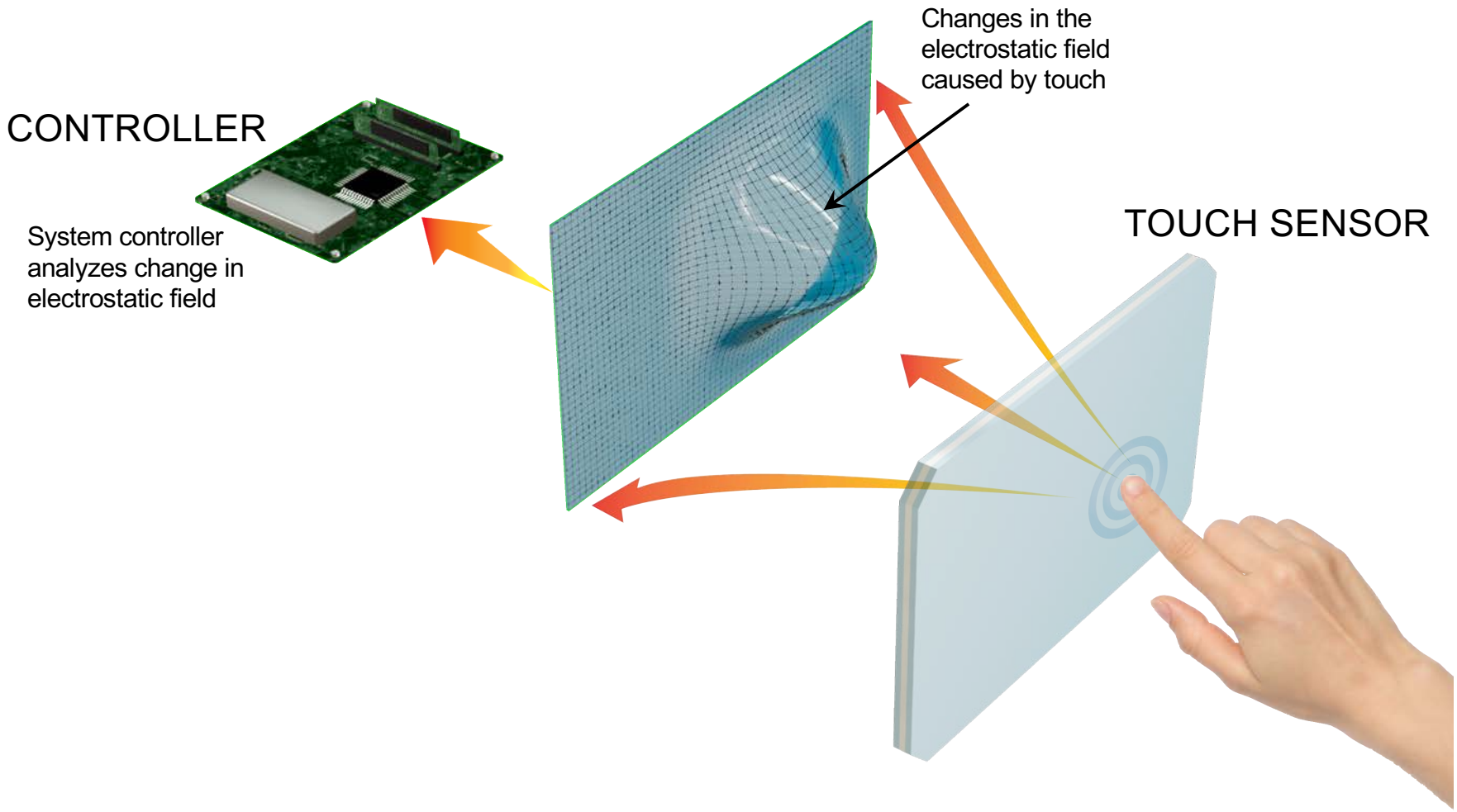
Capacitive Touch Sensing Employs a Sensor and a Controller To Report Touch Coordinates



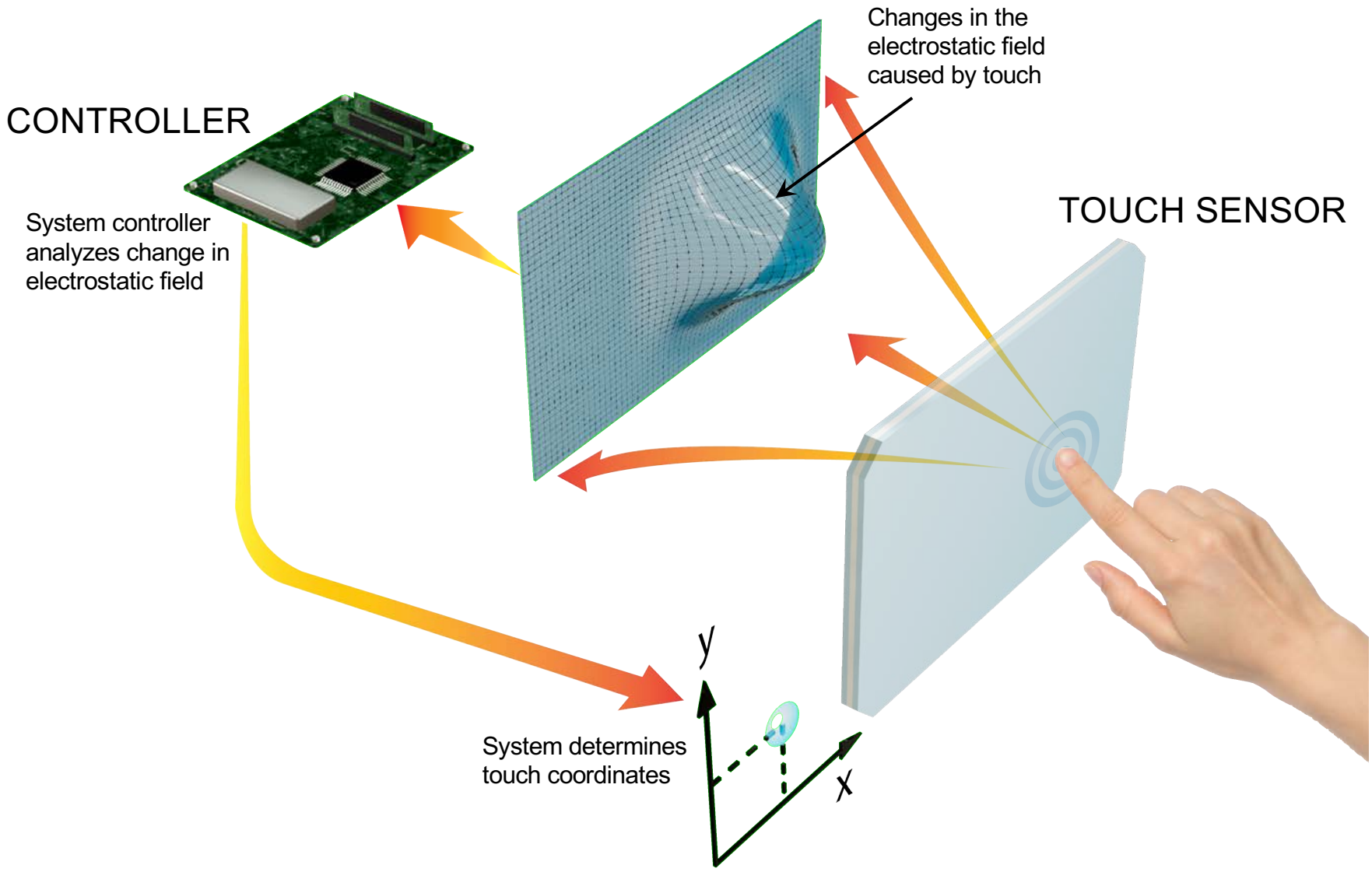
Capacitive Touch Sensing Employs a Sensor and a Controller To Report Touch Coordinates



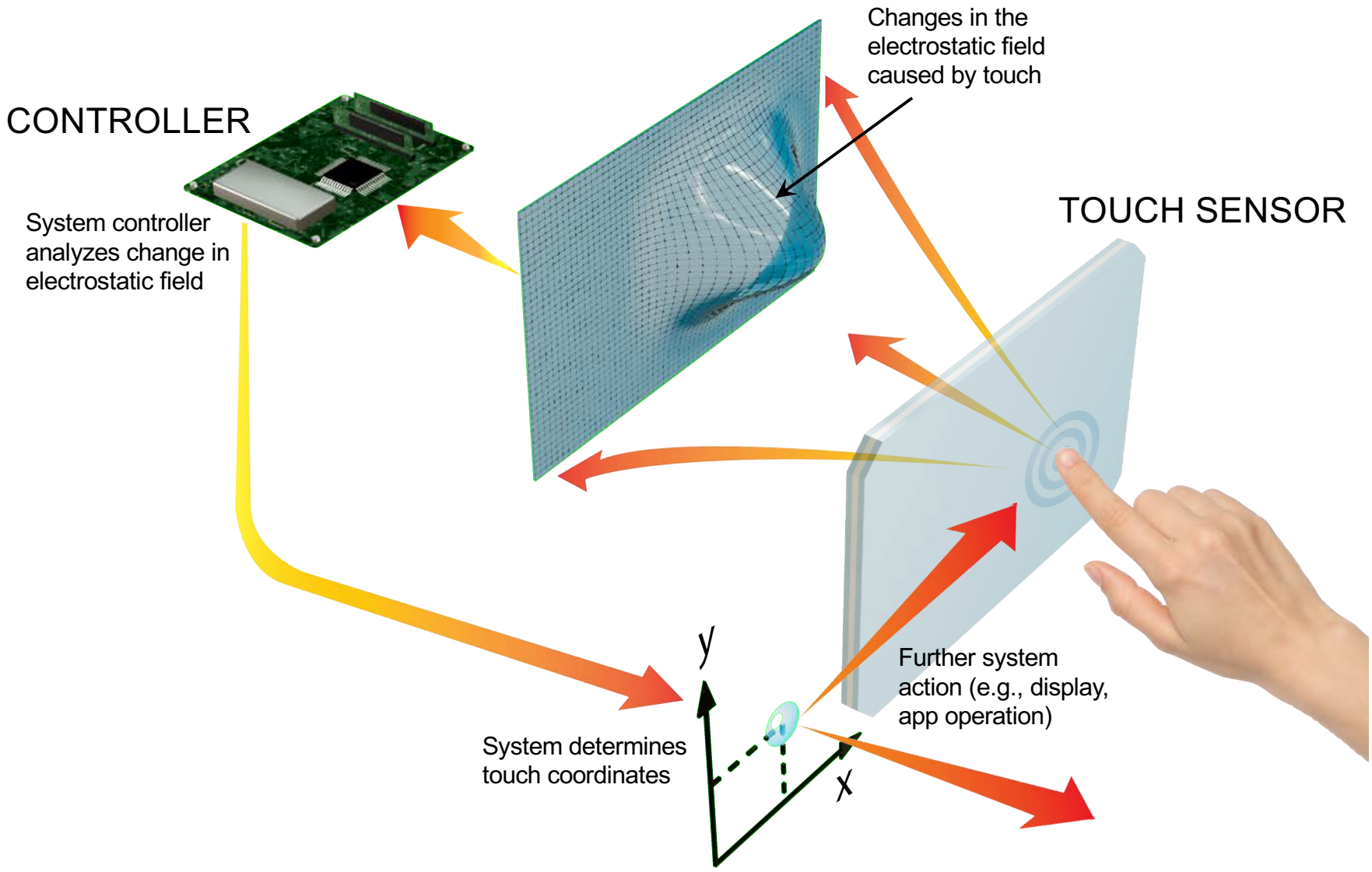
Capacitive Touch Sensing Employs a Sensor and a Controller To Report Touch Coordinates



Capacitive Touch Sensing Employs a Sensor and a Controller To Report Touch Coordinates

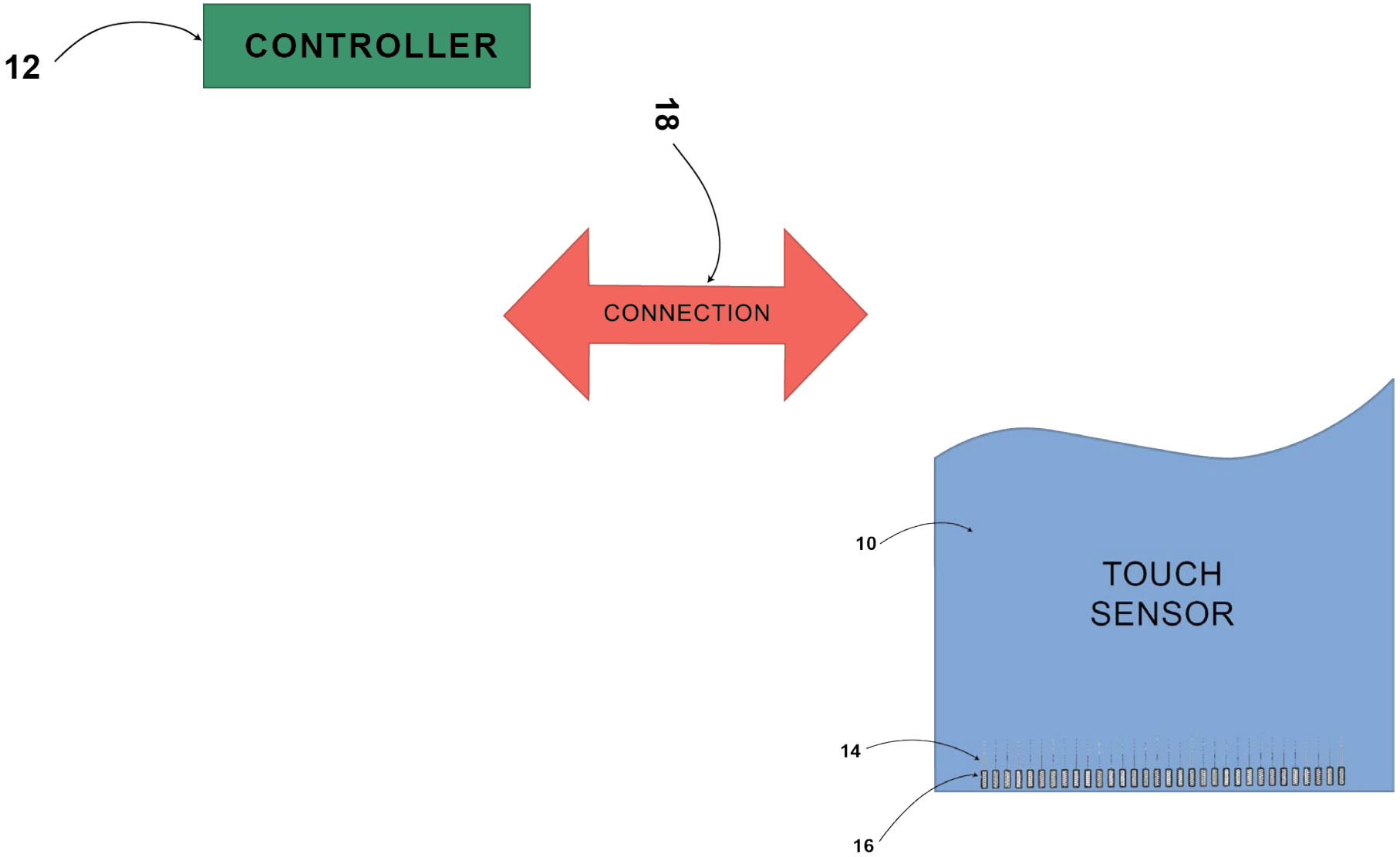


Capacitive Touch Sensing Employs a Sensor and a Controller To Report Touch Coordinates



The '311 Patent Teaches A Novel Sensor Combination To Provide Flexibility For Devices With Different Surfaces

Components in Fig. 1



The '311 Patent Teaches A Novel Sensor Combination To Provide Flexibility For Devices With Different Surfaces

Figure 1

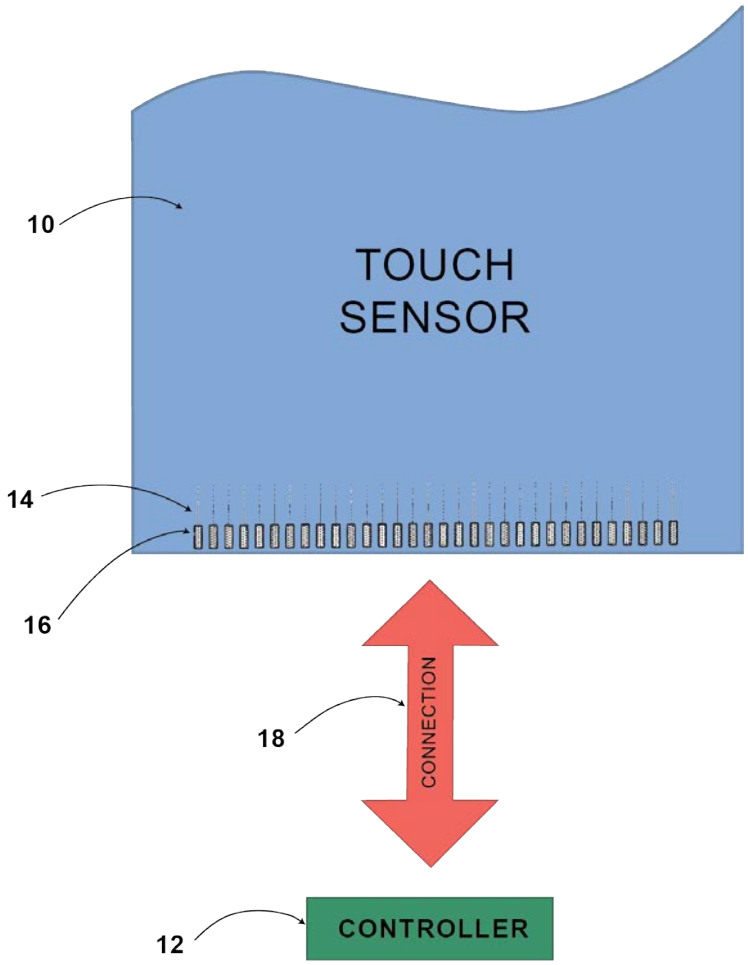


Figure 1

Figure 7 Illustration + Various Different Written Teachings

FIG. 7 illustrates an example mobile telephone that incorporates a flexible touch-sensitive apparatus.

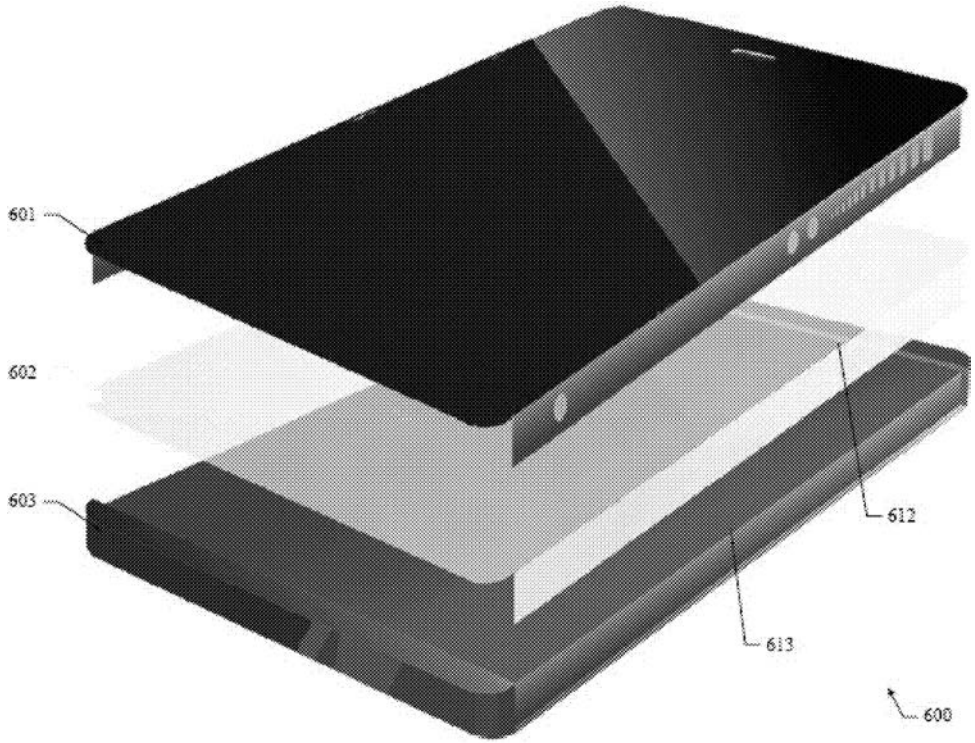


Figure 7

Figure 7 Illustration + Various Different Written Teachings

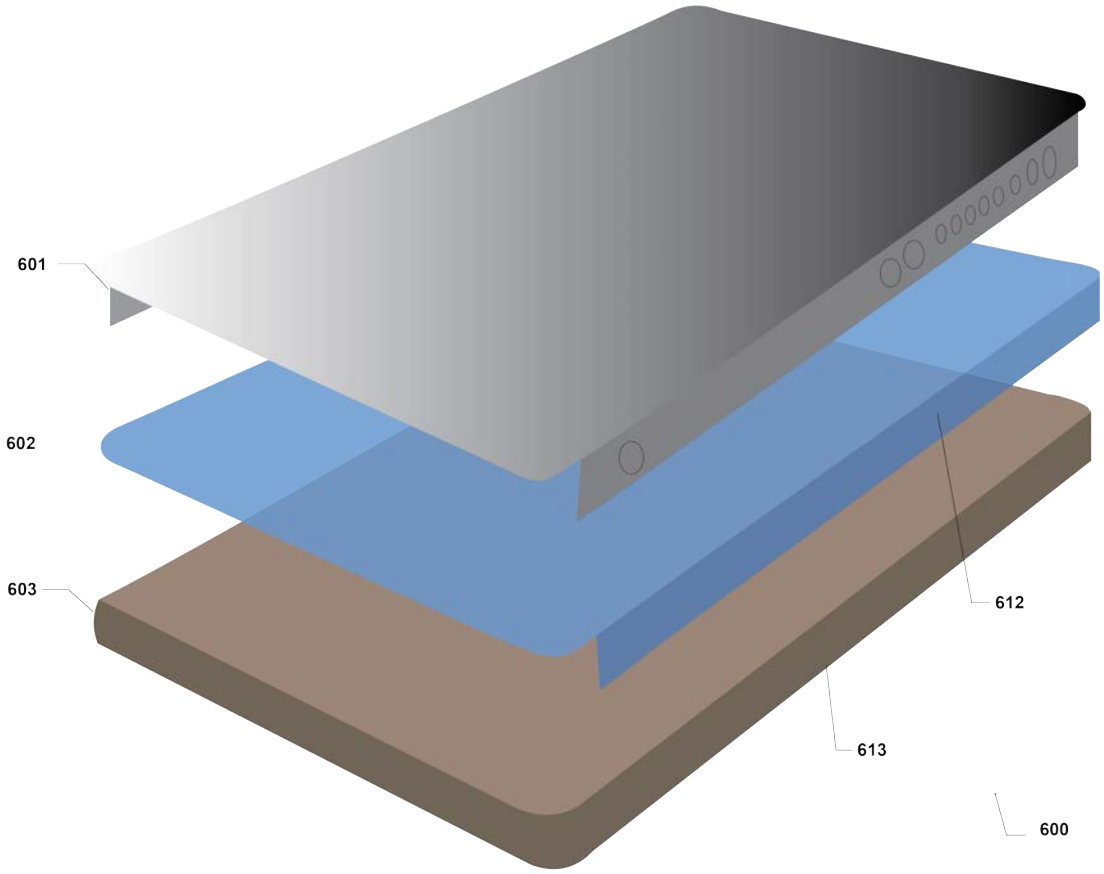


Figure 7

Figure 7 Illustration + Various Different Written Teachings

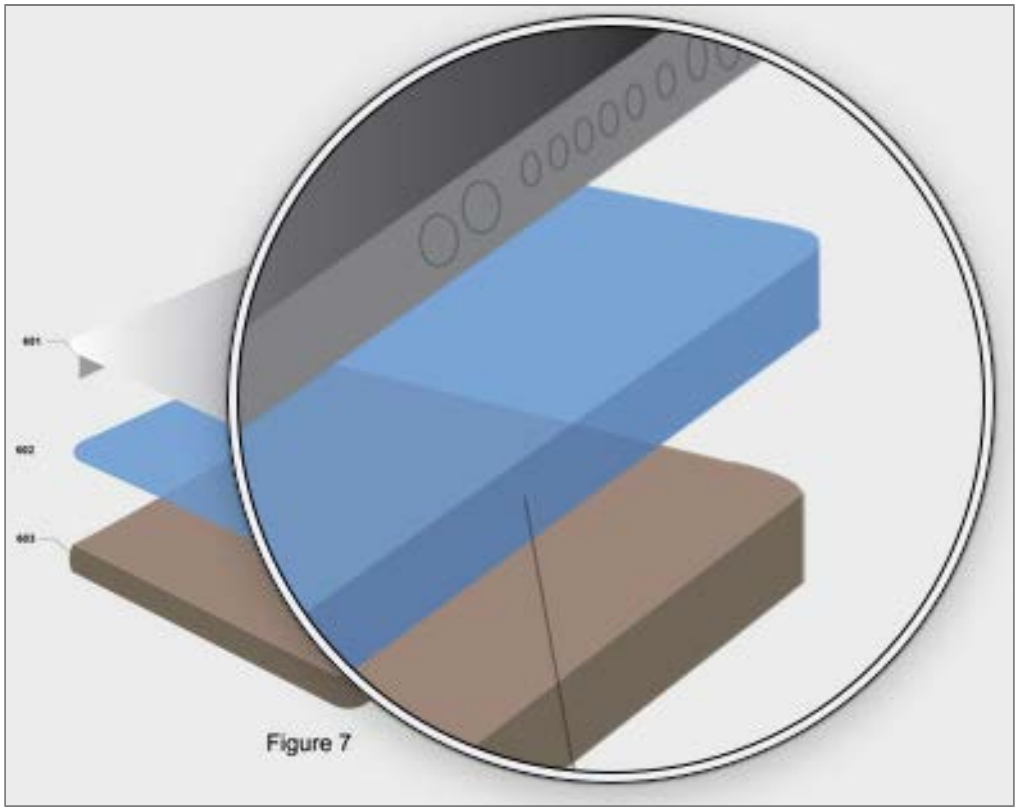


Figure 7

‘311 Col. 7 47:55
Substrate 602 may have the electrode pattern disposed on a surface. Substrate 602 and the conductive material of the electrode pattern may be flexible, enabling the conductive material to wrap around the left and right edges of the Surface to left-side and right-side Surfaces. For sharper edges (e.g., with radii of less than 1 mm), the flexible conductive material of the electrode pattern may be thicker or wider at the sharper edges than at the flat portions of Surfaces.

Figure 7 Alternative Teachings On Shape of Edges: Sharper and And Not

'311 Col. 7 47:55
Substrate 602 may have the electrode pattern disposed on a surface. Substrate 602 and the conductive material of the electrode pattern may be flexible, enabling the conductive material to wrap around the left and right edges of the Surface to left-side and right-side Surfaces. ***For sharper edges (e.g., with radii of less than 1 mm), the flexible conductive material of the electrode pattern may be thicker or wider at the sharper edges than at the flat portions of Surfaces.***

Illustration:
"radii of less than 1 mm"

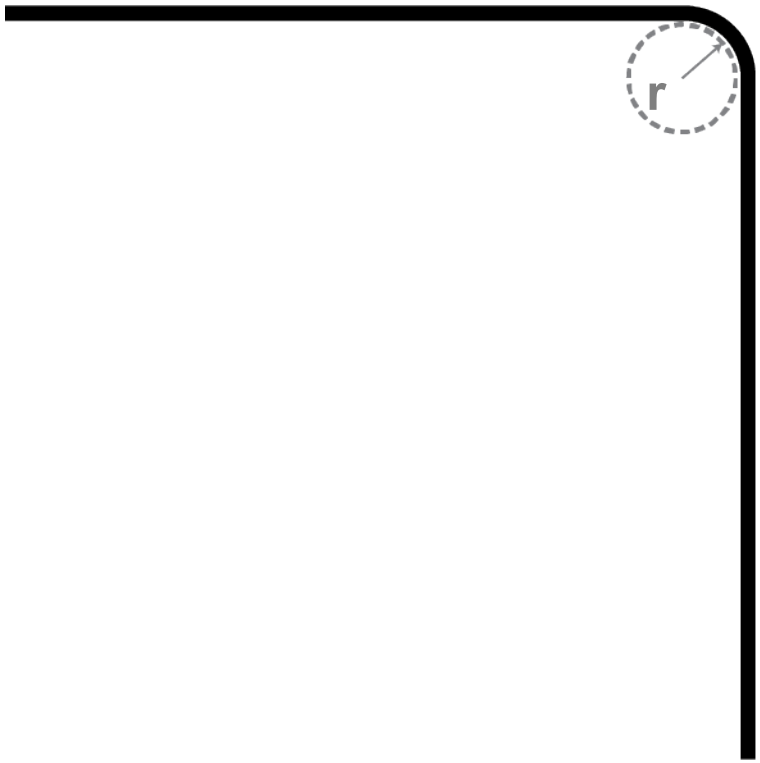


Figure 7 Alternative Teachings On Shape of Edges: Sharper and And Not

'311 Col. 7 47:55
Substrate 602 may have the electrode pattern disposed on a surface. Substrate 602 and the conductive material of the electrode pattern may be flexible, enabling the conductive material to wrap around the left and right edges of the Surface to left-side and right-side Surfaces. ***For sharper edges (e.g., with radii of less than 1 mm), the flexible conductive material of the electrode pattern may be thicker or wider at the sharper edges than at the flat portions of Surfaces.***

Illustration:
"radii greater than 1 mm"

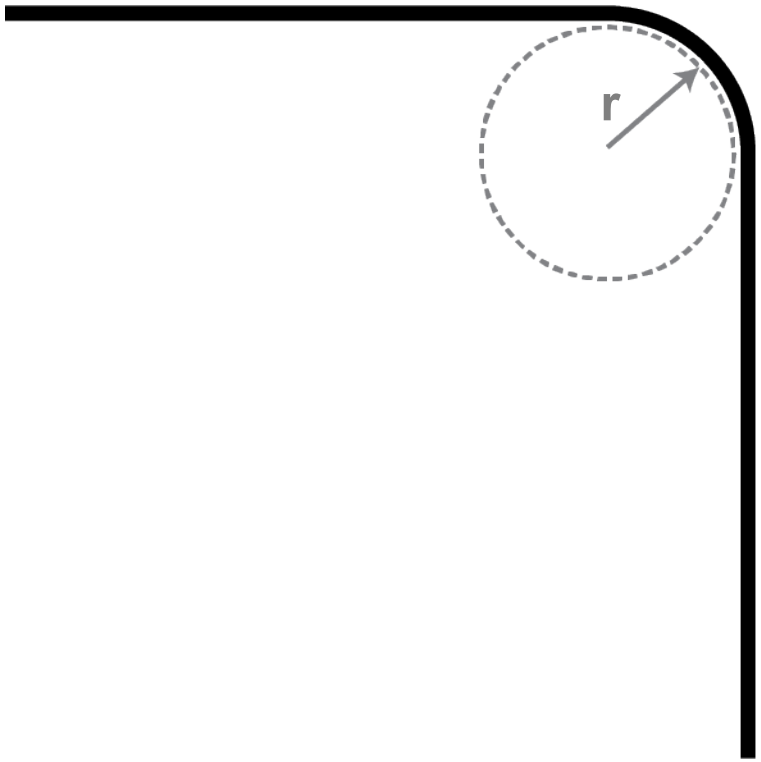


Figure 7 Alternative Teachings On Shape of Edges: Curved

Substrate 602 and the conductive material of the electrode pattern may be flexible, enabling the conductive material to wrap around the left and right edges of the Surface to left-side and right-side Surfaces. For sharper edges (e.g., with radii of less than 1 mm), the flexible conductive material of the electrode pattern may be thicker or wider at the sharper edges than at the flat portions of Surfaces. In particular embodiments, the electrode pattern may wrap around an edge 603 of example mobile phone 600. In other particular embodiments, touch-sensitive apparatus 612 may be wrapped around a curved surface. The curved Surface may be curved in one dimension or in two dimensions. As an example and not by way of limitation, touch sensitive apparatus 612 may be wrapped over Surfaces that are substantially perpendicular to each other ***or, if there is no Substantial distinction between Surfaces (such as, for example, a pebble-shaped or curved device), an angle of deviation between the surfaces of 45° or greater.***

Illustration: curvature "angle of deviation" of 45 degrees